

## UNITED STATES DEPARTMENT OF COMMERCE National Oceanic and Atmospheric Administration

NATIONAL MARINE FISHERIES SERVICE

Alaska Fisheries Science Center
Resource Assessment and Conservation Engineering Division
7600 Sand Point Way Northeast
BIN C15700, Building 4
Seattle, Washington 98115-0070

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Preliminary Cruise Results NOAA Ship *Miller Freeman* Cruise No. MF2001-08

# Acoustic-Trawl Survey of Pacific hake along the West coasts of the United States and Canada

#### Cruise Period, Area, and Schedule

Scientists from the United States and Canada conducted a joint Pacific hake (*Merluccius productus*) echo integration-trawl (EIT) survey along the U.S. and Canadian west coasts during the summer of 2001. The U.S. survey was conducted by scientists from the Alaska Fisheries Science Center (AFSC) aboard the NOAA ship *Miller Freeman* from 15 June to 29 July (a total of 45 sea days). The cruise began and ended in Seattle, Washington. The survey began near Monterey, California and progressed north, ending off Vancouver Island, British Columbia. The Canadian EIT survey was conducted by scientists from the Pacific Biological Station, Department of Fisheries and Oceans, aboard the Canadian Coast Guard ship *W.E. Ricker* from 24 July to 21 August. This report summarizes the preliminary results from the EIT survey conducted by AFSC.

The itinerary for the *Miller Freeman* was as follows:

June 15	Embark scientists in Seattle, Washington and depart for Port Susan
June 15-18	Sphere calibration in Port Susan, Washington; transit to Monterey, California, and collect offshore acoustic system noise measurements
June 19	Begin west coast EIT survey. Touch and go at Monterey to embark scientists
July 3-5	Inport Coos Bay, Oregon, exchange scientists
July 5	Resume west coast EIT survey
July 8	Pier side at Newport, Oregon to repair ship's stack
July 25	Finish EIT survey
July 26-27	Intership calibration with Canadian vessel W. E. Ricker



July 28 Sphere calibration in Port Susan, Washington, disembark scientists

July 29 Arrive Seattle

#### **Objectives**

The primary cruise objective was to collect echo integration data and midwater and bottom trawl data necessary to determine the distribution, biomass, and biological composition of Pacific hake along the U.S. and Canadian west coasts. Secondary objectives were to:

- I. calibrate the 38-kHz and 120-kHz scientific acoustic systems using standard sphere techniques;
- II. collect Pacific hake target strength data for use in scaling echo integration data to estimates of absolute abundance;
- III. collect physical oceanographic data including temperature and salinity profiles at selected sites, and conduct continuous monitoring of sea surface temperature and salinity and water current profiles;
- IV. conduct an intership calibration of acoustic systems between the *Miller Freeman* and the Canadian research vessel *W. E. Ricker*;
- V. collect noise measurements from the acoustic system;
- VI. collect echo integration data, near-surface bongo samples, midwater trawl data, and fluorometry data necessary to determine the distribution and biological composition of macrozooplankton species (e.g., euphausiids) in the survey area;
- VII. collect sediment samples for a surficial sediment map;
- VIII. collect fish for taxonomy instruction; and
- IX. collect near-shore water samples for a bio-toxin study.

#### Methods

#### Sampling Equipment

Acoustic data were collected with a Simrad EK500<sup>1</sup> quantitative echo-sounding system on board

<sup>1</sup> Reference to trade names or commercial firms does not constitute U.S. Government endorsement.

the NOAA ship *Miller Freeman*, a 66-m stern trawler equipped for fisheries and oceanographic research. The Simrad 38-kHz and 120-kHz split-beam transducers were mounted on the bottom of the vessel's centerboard. With the centerboard fully extended, the transducers were 9 m below the water surface. System electronics were housed inside the vessel in a permanent laboratory space dedicated to acoustics. Standard sphere calibrations of both acoustic systems were made in conjunction with the survey. Data from the Simrad EK500 echo sounder/receiver were processed using Simrad BI500 echo integration and target strength data analysis software on a SUN workstation.

Midwater and near-bottom echosign was sampled with an Aleutian Wing 30/26 trawl (AWT), except on four occasions when echosign was sampled with a Marinovich trawl. The AWT is a full-mesh wing trawl constructed of nylon except for polyethylene toward the aft section of the body and the codend. The headrope and footrope both measured 81.7 m (268 ft). Mesh sizes tapered from 3.25 m (10.7 ft) in the forward section of the net to 8.9 cm (3.5 in) in the codend. A 3.2-cm (1.25-in) codend liner was used except on 11 occasions, when a 1.2 cm (0.47-in) liner was used. The AWT was fished with 82.3 m (270 ft) of 1.9-cm (0.75-in) diameter 8x19 (wire) non-rotational dandylines, 227-kg (500-lb) or 340.9-kg (750-lb) tom weights on each side. Meshes in the Marinovich trawl measured 7.6 cm (3.0 in) forward, 3.2 cm (1.25 in) in the codend, and 0.32 cm (0.125 in) in the codend liner. Headrope and footrope lengths were each 9.1 m (30 ft). The Marinovich trawl was fished with 18.3 m (60.0 ft) of 1.27-cm (0.5-in) diameter dandylines, and 227-kg (500-lb) tom weights on each side. Both nets were fished using 5-m² (53.8-ft²) "Fishbuster" doors [1,247 kg (2,750 lb) each].

Fish on and near bottom were sampled with a polyethylene Nor'eastern (PNE) high-opening bottom trawl equipped with roller gear. The PNE was constructed with stretch mesh sizes that ranged from 13 cm (5 in) in the forward portion of the net to 89 mm (3.5 in) in the codend. It was fitted with a nylon codend liner with a mesh size of 32 mm (1.25 in). The 27.2-m (89.1-ft) headrope held 21 floats [30-cm (12-in) diameter]. A 24.7-m (81-ft) chain fishing line was attached to the 24.9-m (81.6-ft) footrope which was constructed of 1-cm (0.4-in) 6 x 19 wire rope wrapped with polypropylene rope. The 24.2-m (79.5-ft) roller gear was constructed with 36-cm (14-in) rubber bobbins spaced 1.5 to 2.1 m (5 to 7 ft) apart. A solid string of 10-cm (4-in) rubber disks separated some of the bobbins in the center section of the roller gear. Two 5.9-m (19.5-ft) wire rope extensions with 10-cm (4-in) and 20-cm (8-in) rubber disks were used to span the two lower flying wing sections and were attached to the roller gear. The roller gear was attached to the fishing line using chain toggles [2.9 kg (6.5 lb.) each] which were comprised of five links and one ring. The trawl was rigged with triple 54.9-m (180-ft) galvanized wire rope dandylines, and was fished with the "Fishbuster" doors.

Midwater or near-surface, smaller organisms were sampled using a Methot trawl or a bongo net. The Methot trawl had a rigid square frame with 2.3-m (7.5-ft) sides forming the mouth of the net. A 1.8-m (6-ft) dihedral depressor modified from an Isaacs-Kidd midwater trawl was suspended below the frame to generate an additional downward force. Mesh sizes were 2 mm x 3 mm (0.08 in x 0.12 in) in the main part of the net and 1 mm (0.04 in) in the codend. The Methot trawl was attached to a single cable that was fed through the ship's stern-mounted A-frame. The bongo net system was deployed from the ship's starboard winch and consisted of a

60cm bongo frame with paired 333-µm mesh nets, and a 46kg lead weight used as a depressor. The Methot trawl and bongo had calibrated flow meters attached to the mouth of the nets to determine the volume of water filtered.

Trawl gears were monitored during sampling for depth, net opening, and other parameters. A WesMar third-wire trawl sonar or a Furuno netsounder system was attached to the headrope of the AWT, PNE, and Marinovich trawls, a Scanmar depth sensor was attached to the Methot trawl frame, and a Sea-Bird CTD system was attached to the bongo frame. Vertical net openings averaged 24 m (78.7 ft) for the AWT, 3 m (9.8 ft) for the Marinovich, and 8 m (26.2 ft) for the PNE.

Physical oceanographic data were collected throughout the cruise. Temperature/depth profile data were obtained with a Seabird SBE39 micro bathythermograph (SBE) attached to the trawl headrope or the Methot frame and conductivity-temperature-depth (CTD) data were collected with a Sea-Bird CTD system at calibrations sites and other selected locations. Expendable bathythermograph (XBT) data were systematically collected to generate vertical temperature profiles every 0.5 degree of latitude along transects at the offshore endpoints, and over bottom depths of about 150 and 400 m. Occasionally, XBT's were deployed at other locations. Sea surface temperature and salinity, environmental data, and data for the Marine Operations Abstract were collected and stored on the *Miller Freeman*'s Scientific Collection System. Ocean current profile data were obtained using the vessel's centerboard-mounted acoustic Doppler current profiler (ADCP) system operating continuously in water-profiling mode. The ADCP was slaved to the EK500 to avoid interference. Vessel pitch and roll data were collected with a POSMV to monitor transducer motion.

#### Survey Methods

The EIT survey consisted of 81 parallel, east-west transects that started near Monterey (Fig. 1) and proceeded north along the U.S. and Canadian west coasts, ending off Vancouver Island. Trackline spacing was about 18.5 km (10 nmi). Nearshore ends of transects ranged between about 30 and 100 m (mean 60 m) while the offshore ends were often in waters deeper than 1,500 m. About 5,487.5 km (2,963 nmi) of transects were run.

Standard survey operations occurred during daylight hours (about 15 hours per day). Night operations were used opportunistically to collect Pacific hake target strength data, conduct trawl hauls on echosign observed during daytime survey operations, investigate aggregations of other midwater fishes and zooplankton, and conduct other ancillary projects. Average vessel speed was 6 m/sec (11-12 knots) when running transects. Acoustic data from the 38-kHz system were collected from 14 m below the surface to within 0.5 m of the bottom except in deeper waters, where data were collected to maximum depths of 500 or 1000 m. Acoustic data from the 120-kHz system were collected to a maximum depth of 250 m. Echo integration data were collected with a horizontal resolution of about 9 m and a vertical resolution of 0.5-2.0 m. The 38-kHz echo integration data were scrutinized by one or more scientists and stored in an INGRES database.

Trawl hauls were made at selected locations to identify echosign and provide biological samples. Average trawling speed was about 1.5 m/sec. Haul duration was kept to the minimum necessary to ensure an adequate sample. Each trawl catch was completely sorted unless it exceeded about 1,000 kg, at which point splits of the catch were sorted. Total weights and numbers of individuals, by species, were determined for each catch. Individual hake were further sampled to determine sex, fork length, body weight, age, and maturity. Both otoliths were removed and stored in a solution of 50% ethanol for subsequent age determination. An electronic scale (Marel M60) was used to determine all weights taken from individual hake specimens. Fish lengths were determined to the nearest cm with a Polycorder measuring device (a combination of a bar code reader and a hand-held computer). Sexual maturities were determined by visual inspection of gonads based on an internationally accepted 8-stage scale (ADP Code Book, 2001, RACE Division, AFSC, Seattle WA 98115).

#### **Data Analysis and Preliminary Results**

#### Standard sphere calibrations

Standard sphere calibrations of the 38-kHz and 120-kHz acoustic systems were conducted before and after the EIT survey (Table 1) in Puget Sound, Washington. No substantial differences in system parameters were observed between the two calibrations.

#### Intership calibration

The *Miller Freeman* and the Canadian research vessel *W.E. Ricker* conducted an intership calibration of their acoustic data collection systems on 26-27 July, to enable comparison of density estimates derived from the two systems. Acoustic data were collected off Vancouver Island along 14 transects, which were variable in length. For each transect, one vessel followed about 1.9 km (1.0 nmi) directly astern of the other. Vessels alternated for lead position at the beginning of transect pairs, with a few exceptions. Vessel speeds were about 4.6 m/s (9 knots). Two hauls were completed following the calibration to identify echosign. Pacific hake dominated the first trawl catch and Pacific herring (*Clupea pallasi*) dominated the second.

#### EIT survey

Biological data and specimens were collected from 76 midwater (i.e., 72 AWT and 4 Marinovich) and 14 bottom trawl hauls (Fig. 1). Trawl station and catch data are summarized in Table 2. Pacific hake was the dominant fish species captured in the AWT hauls by weight and numbers, followed by Pacific herring (*Clupea pallasi*) and walleye pollock (*Theragra chalcogramma*; Table 3). Herring were mostly caught north of the U.S.-Canadian border (near La Perouse Bank) and south of Nootka Sound, off Vancouver Island. Pollock were mostly caught off Cape Flattery and over La Perouse Bank, and a few were captured off central Washington. Euphausiids were most often captured in the Marinovich trawl hauls. Pacific hake

was the most dominant species by weight caught in bottom trawl hauls, followed by splitnose rockfish (S. diploproa; Table 4). Types of Pacific hake biological data, numbers of samples and measurements collected from midwater and bottom trawls are listed in Table 5. Trawl station and catch data from 59 Methot trawl hauls are summarized Figure 2 and Table 6. Twenty bongo tows were completed; sample locations are also depicted in Figure 2. Catches from both gear types were dominated by euphausiids and jellyfish.

Pacific hake distribution and size composition varied over the survey area. Most hake were broadly distributed between about Point Reyes and Heceta Head, and in the vicinity of La Perouse Bank; few fish were observed within other regions of the surveyed area (Fig 3).- Although fish south of Heceta Head ranged in size between 24-74 cm FL, the size composition was skewed to the left, with most fish comprising a mode centered at 34 cm (Fig 4). Hake north of Heceta Head ranged in size between 30-72 cm FL, and comprised a single modal size distribution centered at 49 cm (Fig 4).

Temperature profile data were collected at most trawl haul locations (Tables 2 and 6). Additional vertical temperature profile data were collected from 11 CTD and 89 XBT casts conducted throughout the study area (Fig. 5).

#### Target strength data collection

Target strength data were collected on 9 occasions using the hull-mounted transducers. Twenty-two trawl hauls were conducted in association with this work. Hake was the dominant fish captured, with a few exceptions. Target strength data analysis is in progress.

### SCIENTIFIC PERSONNEL

Name Leg 1:	Sex/Nationality	<u>Position</u>	Organization	Dates aboard			
Mike Guttormsen	M/USA	Chief Scientist	AFSC	6/15-7/3			
Phil Porter	M/USA	Computer Specialist	AFSC	6/15-7/3			
Steve de Blois	M/USA	Fish. Biologist	AFSC	6/15-7/3			
Jennifer Jenson	F/USA	Teacher-at-Sea	OLA	6/15-7/3			
Gordie Swartzman	M/USA	Fish. Biologist	UW	6/15-7/3			
John Horne	M/USA	Fish. Biologist	UW	6/19-7/3			
Vickie Lingwood	F/USA	Computer Specialist	AFSC	6/19-7/3			
Bill Karp	M/USA	Fish. Biologist	AFSC	6/19-7/3			
<u>Leg 2</u> :							
Neal Williamson	M/USA	Chief Scientist	AFSC	7/3-7/28			
Taina Honkalehto	F/USA	Fish. Biologist	AFSC	7/4-7/28			
Mike Brown	M/USA	Computer Specialist	AFSC	7/3-7/28			
Denise McKelvey	F/USA	Fish. Biologist	AFSC	7/3-7/28			
Sarah Stienessen	F/USA	Fish. Biologist	AFSC	7/3-7/28			
Dale Hanson	M/USA	Fish. Biologist	AFSC	7/3-7/28			
Andreas Winter	M/USA	Fish. Biologist	UW	7/3-7/28			
Catherine Roberts	F/USA	Teacher-at-Sea	OLA	7/3-7/28			
Angela Cheng	F/USA	Fish. Biologist	NWFSC	7/4-7/28			
Sara Howlett	F/USA	Fish. Biologist	NWFSC	7/4-7/28			
NWFSC Nort OLA NOA	VFSC Northwest Fisheries Science Center, Seattle, WA  NOAA Office of Legislative Affairs, Teachers at Sea Program, Wash. DC						

Table 1. Results from sphere calibrations conducted before and after the 2001 echo integration-trawl survey of Pacific hake along the U.S./Canada west coast, MF2001-08.

		Frequency	Water Ten	np (°C)	Sphere Range from Transducer	TS Gain	SV Gain	Along 3 dB Beam Width	Angle	Offset
Date	Location	(kHz)	at Transducer <sup>1</sup>	at Sphere	(m)	(dB)	(dB)	(deg)	Along	Athwart
15-Jun	Port Susan, WA	38	10.7	9.4	26.2	25.6	25.4	-	-	-
	···	120	10.7	9.4	20.5	25.4	25.5	-	-	-
28-Jul	Port Susan, WA	38	11.7	10.0	28.7	25.5	25.3	6.92	-0.09	0.01
		120	11.7	10.3	23.4	26.2	26.1	7.18	0.09	0.25
Jun-Jul	System settings	38	-	-	-	25.8	25.5	6.90	-0.08	0.03
	during surveys	120	-	-	-	25.6	25.6	7.30	-0.12	-0.21

SV threshold used for post-processing = -69 dB

Note: Gain and beam pattern terms are defined in the "Operator Manual for Simrad EK500 Scientific Echo Sounder (1993)" available from Simrad Subsea A/S, Strandpromenaden 50, P.O. Box 111, N-3191 Horten, Norway.

<sup>&</sup>lt;sup>1</sup>The transducer was located approximately 9 m below the water surface.

Table 2. Trawl station and catch data summary from the 2001 echo integration-trawl survey of Pacific hake along the U.S./Canada west coast, MF2001-08.

											Temp.		Catch	
Haul	Gear	Date	Time	Duration		t Position		h (m)	Temp.		Profiler	<u>P. h</u>		<u>Other</u>
no.	type	(2001)	(GMT)	(min.)	Latitude	Longitude	Gear l	Bottom	Gear S	Surface	<u>N</u> o.	(kg)	Number	(kg)
1	172	19-Jun	19:26	10	36 18.11	122 1.51	109	109	9.3	11.8	302	0.0	0	55.0
2	317	20-Jun	19:37	30	37 8.10	122 45.19	183	451	8.5	12.5	306	17.9	69	2.6
3	172	21-Jun	4:02	20	37 18.94	122 53.69	272	272	7.4	13.6	307	433.5	1,650	1,146.5
4	317	21-Jun	17:59	30	37 38.24	123 5.64	157	565	8.5	11.1	309	7.4	28	0.8
5	317	22-Jun	14:49	3	38 8.23	123 28.02	166	334	8.1	9.8	314	683.5	1,698	2.9
6	317	23-Jun	1:47	6	38 28.28	123 36.50	162	242	7.9	9	315	745.9	2,970	5.7
7	317	23-Jun	14:25	22	38 37.79	123 26.94	70	83	8.5	9.4	318	368.8	546	14.2
8	317	24-Jun	1:57	5	39 6.26	124 11.19	62	1,489	10.1	11.5	319	0.0	0	0.0
9	317	24-Jun	14:48	3	39 8.11	123 55.78	122	140	8.3	9.9	323	2,260.0	8,595	0.0
10	317	25-Jun	4:23	15	39 48.16	124 1.04	139	152	7.8	10.4	324	241.0	946	0.2
11	172	25-Jun	5:59	4	39 48.17	124 0.85	152	152	7.7	10.7	325	700.5	2,163	172.4
12	317	25-Jun	8:34	15	39 48.19	124 1.04	142	151	7.7	10.3	326	222.3	782	17.1
13	317	25-Jun	15:35	4	39 58.03	124 33.04	84	1,091	8.6	9.6	327	1,279.1	4,378	6.9
14	317	26-Jun	0:12	12	40 18.12	124 37.95	99	904	8.1	13.3	328	1,229.2	3,837	5.3
15	317	27-Jun	13:40	12	41 7.65	124 17.00	93	96	8	13	335	774.6	1,270	14.2
16	317	27-Jun	21:27	3	41 18.08	124 24.23	149	161	7.5	12.1	336	2,732.4	11,021	17.6
17	172	28-Jun	8:46	5	41 23.05	124 9.43	49	49	8.5	11.7	339	0.0	0	15.8
18	172	28-Jun	9:39	15	41 22.49	124 9.43	47	47	8.4	11.1	340	3.1	2	329.9
19	172	28-Jun	14:15	4	41 38.14	124 12.69	36	45	8.1	11.2	341	0.0	0	5.9
20	317	28-Jun	17:17	9	41 38.05	124 22.54	91	98	7.9	14.5	342	2,452.1	8,751	27.9
21	317	29-Jun	2:11	2	41 47.97	124 25.13	72	115	7.8	12.6	343	5,295.9	13,728	4.1
22	317	29-Jun	16:30	23	41 57.72	124 52.37	310	794	6.4	12.4	346	139.8	383	0.6
23	172	30-Jun	0:49	5	42 17.67	124 29.54	98	98	7.6	11.4	347	3,209.7	5,816	4.3
24	305	30-Jun	8:21	15	42 17.88	124 40.99	31	400	9.8	12.6	350	0.0	0	2.2
25	317	30-Jun	15:06	15	42 27.90	124 49.22	277	334	7	12.4	352	1,677.9	5,047	2.1
26	172	1-Jul	5:05	13	42 47.96	124 42.84	61	144	8.4	12.2	353	1.0	2	3.8

Table 2. Continued.

											Temp.		Catch	
Haul	Gear	Date	Time	Duration	Star	t Position	Dept	<u>h (m)</u>	Temp.	(°C)	Profiler	P. h	ake_	<u>Other</u>
no.	type <sup>1</sup>	(2001)	(GMT)	(min.)	Latitude	Longitude	Gear l	Bottom	Gear S	Surface	No.	(kg)	Number	(kg)
27	172	1-Jul	6:33	16	42 48.03	124 42.79	60	142	8	12.1	354	7.6	19	3.8
28	317	1-Jul	19:04	9	43 7.30	124 50.82	170	289	7.2	13.7	355	3,220.0	8,539	0.0
29	305	2-Jul	6:12	10	43 28.16	124 20.63	18	85	10.9	12.1		1.6	2	2.2
30	305	2-Jul	7:31	15	43 28.12	124 20.91	19	86	9.7	12.1	356	0.0	0	2.4
31	305	2-Jul	8:33	20	43 28.11	124 19.65	15	74	10.2	11.9	357	0.0	0	0.5
32	317	2-Jul	17:14	3	43 37.68	124 25.53	118	123	7.2	13.3	360	1,240.0	3,569	2.1
33	317	3-Jul	0:55	2	43 47.85	124 34.07	194	198	6.9	14.2	361	546.4	1,093	0.0
34	317	6-Jul	16:11	42	43 57.21	124 26.79	115	124	7.4	12	366	224.4	456	120.9
35	317	7-Jul	16:19	5	44 18.13	124 50.70	189	224	7	12.6	369	1,250.7	1,972	9.3
36	317	11-Jul	5:05	30	45 18.05	124 46.54	478	568	5.5	15	373	23.1	35	9.4
37	317	12-Jul	4:02	41	45 48.12	124 11.96	96	102	7	13.1	376	362.7	478	0.1
38	317	12-Jul	10:08	25	45 48.11	124 10.82	92	99	7.1	12.6	377	259.7	332	0.1
39	317	13-Jul	1:06	23	46 8.17	124 36.94	128	158	7.1	13.2	379	0.0	0	2,340.0
40	317	13-Jul	13:05	1	46 17.49	124 15.82	67	72	7.4	13.2	380	0.0	0	9.1
41	317	13-Jul	15:20	5	46 17.42	124 15.91	66	73	7.4	13.2	381	0.0	0	24.7
42	317	14-Jul	14:36	27	46 38.17	124 19.46	63	67	7.8	12.2	384	0.0	0	109.3
43	172	14-Jul	16:13	20	46 38.26	124 17.97	68	68	7.2	11.9	385	1.2	1	223.1
44	317	15-Jul	0:42	28	46 48.21	124 53.68	305	352	6.1	14	386	170.2	249	5.0
45	317	15-Jul	5:29	30	46 48.08	124 22.74	66	74	7.7	12	387	221.8	262	16.6
46	317	15-Jul	10:49	26	46 48.07	124 23.15	63	74	7.6	12.1	388	694.5	828	11.7
47	317	15-Jul	17:35	19	46 58.13	125 5.90	152	1,000	7.5	14.1	389	3.3	4	0.6
48	317	15-Jul	23:54	40	47 8.09	124 37.23	70	80	7.5	11.9	390	1,134.7	1,469	28.8
49	317	16-Jul	6:14	30	47 16.72	124 33.37	59	68	7.7	12.2	391	1,544.9	1,814	39.1
50	317	16-Jul	10:23	16	47 17.38	124 33.46	56	67	7.9	11.4	392	1,222.6	1,475	39.3
51	317	16-Jul	23:01	30	47 28.14	124 56.18	302	401		12.9	394	100.4	141	3.8
52	317	17-Jul	2:51	43	47 28.14	124 38.82	71	84	7.6	12.2	395	163.3	201	29.5

Table 2. Continued.

											Temp.		Catch	
Haul	Gear	Date	Time	Duration		Position	Depth		Temp.		Profiler	<u>P. h</u>		<u>Other</u>
no.	type <sup>1</sup>	(2001)	(GMT)	(min.)	Latitude	Longitude	Gear B	ottom	Gear S	urface	No.	(kg)	Number	(kg)
53	317	17-Jul	7:38	32	47 28.03	124 38.80	71	82	7.6	12.5	396	266.7	317	8.9
54	317	17-Jul	16:13	32	47 38.11	125 1.37	156	171	7	13.9	398	2.3	3	191.6
55	172	18-Jul	1:01	16	47 48.12	124 51.34	97	97	6.8	13.1	399	3,742.3	4,628	247.7
56	317	18-Jul	17:41	. 37	47 56.52	125 16.66	308	362	5.9	14.5	403	359.9	456	21.6
57	317	19-Jul	14:55	16	48 18.20	125 3.37	82	193	6.9	12.5	408	353.1	343	2,379.5
58	172	19-Jul	21:41	10	48 17.98	125 54.34	234	234	6	13.2	410	14.0	20	3,156.0
59	317	20-Jul	6:42	29	48 28.11	125 55.07	104	141	7.5	13.8	411	20.7	20	276.5
60	317	20-Jul	17:01	25	48 28.02	125 42.62	94	104	6.9	11.6	414	0.0	0	98.8
61	317	20-Jul	20:12	27	48 28.06	125 30.25	100	118	6.6	11.6	415	398.9	391	2,831.1
62	317	20-Jul	23:06	32	48 28.13	125 2.27	70	145	6.7	11.8	416	196.8	208	2,743.2
63	317	21-Jul	1:32	6	48 28.16	125 4.53	124	152	6.5	12.2	417	2,337.3	2,492	40.7
64	317	21-Jul	4:21	1	48 28.25	124 44.56	64	260	7.9	11.3	418	52.8	61	123.8
65	317	21-Jul	8:22	2	48 34.66	124 52.29	51	72	9.6	11.7	419	0.0	0	71.9
66	317	21-Jul	9:59	8	48 33.44	124 52.61	68	83	8.2	11.5	420	2.4	2	2,531.1
67	317	21-Jul	16:30	12	48 38.09	125 20.49	102	112	7 ·	11.9	421	462.0	474	828.0
68	317	21-Jul	21:17	17	48 38.13	125 59.89	102	110	7.6	14.3	422	0.0	0	180.6
69	317	22-Jul	5:07	20	48 48.15	126 24.97	211	235	6.3	12.5	423	158.3	188	20.0
70	317	22-Jul	7:06	30	48 48.13	126 24.42	124	228	7.4	12.7	424	353.6	465	4.9
71	317	22-Jul	10:40	25	48 43.86	126 12.87	140	157	7.1	13	425	0.0	0	71.3
72	317	22-Jul	15:15	17	48 48.18	126 5.39	94	103	7.5	14	427	0.0	0	22.9
73	317	22-Jul	17:38	15	48 48.18	126 17.40	151	162	6.9	12.4	428	0.0	0	342.1
74	317	22-Jul	22:16	15	48 48.13	125 28.15	97	105	8.2	14.2	429	2.9	2	23.3
75	317	23-Jul	5:58	30	48 58.10	126 20.10	107	141	7.3	14.1	430	134.2	144	19.7
76	317	23-Jul	7:50	15	48 58.06	126 20.05	46	139	8.2	13.7	431	0.0	0	4.1
77	317	23-Jul	9:47	25	48 58.08	126 13.19	102	116	7.3	14.1	432	237.9	268	7.3
78	317	23-Jul	12:38	11	48 58.09	126 12.99	95	110	7.4	13.9	433	4.0	5	82.6

Table 2. Continued.

													Temp.		Catch	
Haul	Gear	Date	Time	Duration	n	Start	Positi	ion	_Depth	n (m)	Temp.	(°C)	Profiler	_ P. h	nake_	<u>Other</u>
no.	type¹	(2001)	(GMT)	(min.)	La	titude	Lon	gitude	Gear B	ottom	Gear	Surface	No.	(kg)	Number	(kg)
79	172	23-Jul	16:03	20	48	58.12	126	39.49	483	483	5.3	14.1	434	138.4	179	1.3
80	317	23-Jul	23:13	58	49	8.12	126	45.32	137	153	6.8	14.2	435	0.0	0	221.6
81	317	24-Jul	2:53	27	49	8.12	126	31.51	116	125	7.1	12.7	436	22.8	19	549.3
82	317	24-Jul	8:32	30	49	3.18	126	25.92	95	134	7.4	13.4	437	105.3	113	5.8
83	317	24-Jul	12:01	10	49	2.93	126	25.54	102	136	7.3	13.1	438	909.0	953	8.5
84	317	24-Jul	19:16	34	49	17.23	126	56.11	127	151	6.9	12.1	439	3.1	3	50.4
85	172	25-Jul	4:51	44	49	27.41	126	51.98	101	101	7.6	10.9	440	0.2	1	121.2
86	317	25-Jul	11:02	27	49	21.51	126	50.45	112	124	7	10.8	441	0.0	0	88.7
87	317	25-Jul	14:56	21	49	38.14	127	3.36	94	227	7.3	10.8	442	0.0	0	42.2
88	317	25-Jul	21:55	32	49	48.12	127	39.64	183	393	6.8	10.3	443	0.0	0	1,446.9
89	317	27-Jul	15:58	14	49	8.01	126	24.68	95	109	7.3	11.5	448	5,237.3	5,585	14.8
90	317	27-Jul	19:22	21	49	6.35	126	20.00	85	93	7.4	11.1	449	0.0	0	2,784.0

gear type 317 = Aleutian wing trawl, 172 = poly nor'eastern bottom trawl, 305 = Marinovich trawl

Table 3. Catch by species from 72 Aleutian Wing trawl hauls conducted during the 2001 Pacific hake echo integration-trawl survey along the U.S./Canada west coast, MF2001-08.

		We	eight	
Species Name	Scientific Name	<u>(kg)</u>	<u>(%)</u>	<u>Numbers</u>
Pacific hake	Merluccius productus	44,131.8	67.7	99,478
Pacific herring	Clupea pallasi	7,099.7	10.7	83,341
walleye pollock	Theragra chalcogramma	5,891.2	9.0	25,243
yellowtail rockfish	Sebastes flavidus	4,076.2	6.3	2,863
spiny dogfish	Squalus acanthias	2,624.4	4.0	3,118
redstripe rockfish	Sebastes proriger	191.4	0.3	362
chinook salmon	Oncorhynchus tshawytscha	175.8	0.3	74
jellyfish unident.	Scyphozoa	149.2	0.2	-
jack mackerel	Trachurus symmetricus	121.7	0.2	111
Pacific ocean perch	Sebastes alutus	118.4	0.2	84
widow rockfish	Sebastes entomelas	113.7	0.2	65
Chub mackerel	Scomber japonicus	75.6	0.1	124
Pacific sardine	Sardinops sagax	57.5	0.1	330
canary rockfish	Sebastes pinniger	54.6	0.1	24
english sole	Parophrys vetulus	46.2	0.1	271
bocaccio	Sebastes paucispinis	35.9	0.1	8
Pacific sanddab	Citharichthys sordidus	23.3	< 0.1	135
lingcod	Ophiodon elongatus	22.5	< 0.1	4
chilipepper	Sebastes goodei	15.7	< 0.1	16
pink salmon	Oncorhynchus gorbuscha	15.2	< 0.1	9
squid unident.	Teuthoidea	14.5	< 0.1	1,330
Myctophidae	Myctophidae	14.2	< 0.1	14,754
sanddab unident.	Citharichthys sp.	14.1	< 0.1	66
coho salmon	Oncorhynchus kisutch	13.3	< 0.1	7
eulachon	Thaleichthys pacificus	11.9	< 0.1	1,045
Gonatus unident.	Gonatidae	10.4	< 0.1	34
mackerel unident.	Scombridae	10.3	< 0.1	6
salps unident.	Thaliacea unident.	8.5	< 0.1	57
chum salmon	Oncorhynchus keta	8.1	< 0.1	2
longnose skate	Raja rhina	5.7	< 0.1	1
whitebait smelt	Allosmerus elongatus	5.7	< 0.1	698
shrimp unident.	Decapoda	5.1	< 0.1	120
silvergray rockfish	Sebastes brevispinis	4.9	< 0.1	2
bigfin eelpout	Lycodes cortezianus	3.9	< 0.1	481
American shad	Alosa sapidissima	3.1	< 0.1	14
flathead sole	Hippoglossoides elassodon	3.1	< 0.1	38
Berryteuthis magister	Berryteuthis magister	2.9	< 0.1	5
sablefish	Anoplopoma fimbria	2.1	< 0.1	3
starry flounder	Platichthys stellatus	1.8	< 0.1	2
black rockfish	Sebastes melanops	1.8	< 0.1	. 1
brown cat shark	Apristurus brunneus	1.0	< 0.1	1

Table 3. Continued.

		$\underline{\mathbf{W}}$	eight .	
Species Name	Scientific Name	<u>(kg)</u>	<u>(%)</u>	Numbers
slender sole	Lyopsetta exilis	1.0	< 0.1	14
smelt unident.	Osmeridae	0.8	< 0.1	82
Pacific viperfish	Chauliodus macouni	0.5	< 0.1	47
euphausiid unident.	Euphausiacea	0.5	< 0.1	287
Lampanyctus sp.	Lampanyctus sp.	0.4	< 0.1	9
arrowtooth flounder	Atheresthes stomias	0.3	< 0.1	2
lamprey unident.	Petromyzontidae	0.3	< 0.1	13
Pacific lamprey	Lampetra tridentata	0.2	< 0.1	11
octopus unident.	Octopoda	0.2	< 0.1	1
shortspine thornyhead	Sebastolobus alascanus	0.1	< 0.1	2
ribbon barracudina	Notolepsis risso	0.1	< 0.1	6
longfin dragonfish	Tactostoma macropus	0.1	< 0.1	3
northern anchovy	Engraulis mordax	0.0	< 0.1	1
warty poacher	Occella verrucosa	0.0	< 0.1	1
fish larvae unident.	Teleostei	0.0	< 0.1	8
flatfish larvae	Pleuronectiformes larvae	0.0	< 0.1	4
poacher unident.	Agonidae	0.0	< 0.1	1
Totals		65,190.8		234,932

Table 4. Catch by species from 14 bottom trawl hauls conducted during the 2001 Pacific hake echo integration-trawl survey along the U.S./Canada west coast, MF2001-08.

MF2001-08.				
O	C. i A.C. N N.		eight	NT 1
Species Name	Scientific Name	<u>(kg)</u>	<u>(%)</u>	Numbers
Pacific hake	Merluccius productus	8,251.5	60.1	14,481
splitnose rockfish	Sebastes diploproa	2,075.4	15.1	4,664
Pacific ocean perch	Sebastes alutus	1,485.9	10.8	1,600
sharpchin rockfish	Sebastes zacentrus	364.6	2.7	1,950
Pacific sanddab	Citharichthys sordidus	247.4	1.8	2,961
jellyfish unident.	Scyphozoa	172.9	1.3	-
Dover sole	Microstomus pacificus	169.9	1.2	638
redstripe rockfish	Sebastes proriger	162.2	1.2	90
spiny dogfish	Squalus acanthias	117.1	0.9	168
walleye pollock	Theragra chalcogramma	98.3	0.7	498
Pacific tomcod	Microgadus proximus	97.7	0.7	2,435
darkblotched rockfish	Sebastes crameri	77.2	0.6	114
english sole	Parophrys vetulus	71.9	0.5	532
rex sole	Glyptocephalus zachirus	57.2	0.4	445
yellowtail rockfish	Sebastes flavidus	55.1	0.4	42
sablefish	Anoplopoma fimbria	26.7	0.2	29
rosethorn rockfish	Sebastes helvomaculatus	24.4	0.2	75
Pacific sardine	Sardinops sagax	16.4	0.1	181
blue shark	Prionace glauca	15.1	0.1	1
bigfin eelpout	Lycodes cortezianus	12.2	0.1	135
shortspine thornyhead	Sebastolobus alascanus	11.5	0.1	79
Pacific cod	Gadus macrocephalus	10.7	0.1	7
spotted ratfish	Hydrolagus colliei	10.4	0.1	20
Pacific herring	Clupea pallasi	9.1	0.1	238
silvergray rockfish	Sebastes brevispinis	8.1	0.1	4
longnose skate	Raja rhina	7.9	0.1	3
lingcod	Ophiodon elongatus	6.5	< 0.1	3
arrowtooth flounder	Atheresthes stomias	5.9	< 0.1	29
Chub mackerel	Scomber japonicus	5.0	< 0.1	8
smelt unident.	Osmeridae	4.9	< 0.1	415
canary rockfish	Sebastes pinniger	4.7	< 0.1	3
petrale sole	Eopsetta jordani	4.7	< 0.1	5
slender sole	Lyopsetta exilis	4.3	< 0.1	77
lamp shells	Brachiopoda	4.3	< 0.1	260
sponge unident.	Porifera	3.7	< 0.1	1
squid unident.	Teuthoidea	3.7	< 0.1	176
widow rockfish	Sebastes entomelas	3.7	< 0.1	3
chinook salmon	Oncorhynchus tshawytscha	2.7	< 0.1	3
rougheye rockfish	Sebastes aleutianus	2.4	< 0.1	1
bocaccio	Sebastes paucispinis	2.1	< 0.1	2
Actiniaria	Actiniaria	2.1	< 0.1	13
salps unident.	Thaliacea	2.0	< 0.1	80

Table 4. Continued.

		<u>w</u>	eight	
Species Name	Scientific Name	<u>(kg)</u>	<u>(%)</u>	<u>Numbers</u>
northern anchovy	Engraulis mordax	1.8	< 0.1	199
octopus unident.	Octopoda	1.7	< 0.1	3
shrimp unident.	Decapoda	1.7	< 0.1	135
brown rockfish	Sebastes auriculatus	1.6	< 0.1	1
black rockfish	Sebastes melanops	1.6	< 0.1	1
American shad	Alosa sapidissima	1.6	< 0.1	3
sanddab unident.	Citharichthys sp.	1.3	< 0.1	14
flathead sole	Hippoglossoides elassodon	1.3	< 0.1	18
shortbelly rockfish	Sebastes jordani	1.0	< 0.1	35
redbanded rockfish	Sebastes babcocki	0.9	< 0.1	3
starfish unident.	Asteroidea	0.8	< 0.1	5
Pacific staghorn sculpin	Leptocottus armatus	0.5	< 0.1	4
dungeness crab	Cancer magister	0.5	< 0.1	1
sea cucumber unident.	Holothuroidea	0.4	< 0.1	3
big skate	Raja binoculata	0.3	< 0.1	2
butter sole	Isopsetta isolepis	0.3	< 0.1	2
California skate	Raja inornata	0.3	< 0.1	1
eelpout unident.	Zoarcidae	0.2	< 0.1	3
chiton unident.	Polyplacophora	0.2	< 0.1	1
kelp crab	Pugettia sp.	0.2	< 0.1	1
sea pen unident.	Pennatulacea	0.2	< 0.1	3
hybrid sole	Inopsetta ischyra	0.1	< 0.1	1
spot shrimp	Pandalus platyceros	0.1	< 0.1	3
white croaker	Genyonemus lineatus	0.1	< 0.1	1
basketstarfish	Gorgonocephalus caryi	0.1	< 0.1	2
sculpin unident.	Cottidae	0.1	< 0.1	1
whitebait smelt	Allosmerus elongatus	0.1	< 0.1	18
Pacific saury	Cololabis saira	0.1	< 0.1	3
plainfin midshipman	Porichthys notatus	0.0	< 0.1	1
Myctophidae	Myctophidae	0.0	< 0.1	4
fish unident.	Teleostei	0.0	< 0.1	1
viperfish unident.	Chauliodontidae	0.0	< 0.1	1
m . 1		12.722.4		22.040

Totals 13,738.4 32,948

Table 5. Pacific hake biological samples and measurements collected during the 2001 echo integration-trawl survey along the U.S./Canada west coast, MF2001-08.

.5./Canac	S. Callada west coast, Wil 2001-00.									
<u>Haul</u> 1	Length	Maturity	Otoliths	Fish Weight						
2	69	31	31	31						
3	366	50	50	50						
4	28	28	28	28						
5	411	26 76	26 76	26 76						
6	844									
7	334	56 51	56 51	56 51						
8	33 <del>4</del>	51	51	51						
9	614	42	42	42						
10	360	44	44	42 44						
11	334	52	52	52						
12	290		32	32						
13	345	- 54	<u>-</u> 54	54						
14	308	51	51	51						
15	424	56	56	56						
16	457	54	54	54						
17	437	J <b>-</b>	J <b>4</b>	J <b>4</b>						
18	_	_	_	_						
19	_	_	_	_						
20	372	42	42	42						
21	572	50	50	68						
22	293	39	39	39						
23	289	49	49	49						
24	-		-	-						
25	422	40	40	40						
26	2	-	-	-						
27	19	_	_	_						
28	328	52	52	52						
29	2	-	<u>-</u>	-						
30	-	-	_	_						
31	_	-	_	_						
32	413	44	44	44						
33	377	40	40	40						
34	396	60	60	60						
35	314	37	37	37						
36	35	35	35	35						
37	316	42	42	42						
38	290	41	-	42						
39	-	-	-	-						
40	-	-	-	-						
41	-	-	-	-						
42	-	-	-	-						
43	-	-	-	-						
44	249	49	50	50						
45	262	50	51	51						
46	296	60	-	60						
47	4	-	-	-						
48	390	45	45	45						

Table 5. Continued.

				Fish
<u>Haul</u>	Length	<b>Maturity</b>	<b>Otoliths</b>	Weight
49	293	57	57	57
. 50	325	63	-	63
51	141	36	36	36
52	201	39	39	39
53	317	60	-	60
54	-	_	-	-
55	360	81	81	81
56	377	79	79	79
57	343	88	88	88
58	20	20	20	20
59	20	20	20	-
60	-	_	_	_
61	328	63	63	63
62	208	40	208	40
63	370	54	54	54
64	61	_	_	-
65	-	-	-	-
66	-	_	_	-
67	365	65	65	65
68				
69	188	71	72	72
70	300	39	_	39
71	-	- -	-	_
72	-	=	-	-
73	-	=	-	-
74	2	2	2	2
75	144	80	80	80
76	-	-	=	_
77	268	75	75	75
78	5	5	5	5
79	179	78	78	78
80	-	-	-	-
81	19	19	19	19
82	113	73	73	73
83	346	57	_	57
84	2	2	-	2
85	1	1	1	1
86	-	-	-	-
87	-	-	-	-
88	-	-	-	-
89	321	-	-	-
Totals	16,442	2,687	2,536	2,689

Table 6. Methot trawl station and catch data summary from the 2001 echo integration-trawl survey of Pacific hake along the U.S./Canada west coast, MF2001-08.

					,				,			Temp.	
Haul	Date	Time	Duration	Start Position			Depth (m)				Profiler	Catch	
no.	(2001)	(GMT)	(min.)	La	titude	Lon	gitude	Geara	Bottom	Gearb	Surface	No.	(kg)
201	20 Jun	3:12	15	36	48.1	122	0.4	98	483	9.1	11.7	303	3.0
202	20 Jun	9:19	37	36	57.7	122	32.0	116	400	8.7	11.5	304	6.3
203	20 Jun	10:20	27	36	57.7	122	32.1	69	414	8.9	11.5	305	8.5
204	21 Jun	10:08	15	37	27.9	122	55.5	44	150	10.2	12	308	6.3
205	22 Jun	4:17	16	37	57.7	123	22.3	53	107	9.1	9.5	310	18.2
206	22 Jun	9:57	22	38	7.7	123	28.1	97	368	8.4	9.1	311	2.0
207	22 Jun	10:48	9	38	7.9	123	28.3	22	365	9.3	9.5	312	0.5
208	22 Jun	12:21	8	38	8.0	123	38.2	20	1,000	9.3	9.4	313	0.0
209	23 Jun	6:44	25	38	28.1	123	36.2	179	253	7.7	9.1	316	3.0
210	23 Jun	9:19	8	38	27.8	123	47.6	19	1,492	11.1	11.1	317	0.1
211	24 Jun	2:58	12	39	6.0	124	11.2	46	1,472	10	11.5	320	0.1
212	24 Jun	4:26	12	39	8.3	124	10.0	18	998	11	11.5	321	0.0
213	24 Jun	10:45	17	39	17.8	124	4.7	82	647	9.2	10.4	322	2.4
214	26 Jun	3:25	34	40	18.1	125	8.0	215	1,231	7.1	10.4	329	3.6
215	27 Jun	3:53	10	40	58.5	124	15.3	42	71	8.4	9.7	330	1.0
216	27 Jun	4:22	9	40	58.7	124	15.3	19	71	8.8	9.7	331	2.4
217	27 Jun	5:33	11	40	58.4	124	24.9	34	258	11.8	13.7	332	1.3
218	27 Jun	7:22	13	40	58.6	124	23.4	30	193	9	13.7	333	2.5
219	27 Jun	10:39	16	41	8.3	124	23.8	46	371	9.1	13.6	334	4.0
220	28 Jun	3:56	21	41	28.2	124	42.4	102	1,010	8.8	12.9	337	3.0
221	28 Jun	4:43	16	41	28.3	124	42.4	64	1,004	9	12.9	338	9.4
222	29 Jun	7:38	8	41	57.9	125	5.4	32	1,300	10.9		344	0.5
223	29 Jun	10:24	13	41	57.9	124	37.5	35	464	10.1	12.4	345	19.3
224	30 Jun	4:23	15	42	17.5	125	4.2	45	1,000	10.3		348	3.3
225	30 Jun	7:00	12	42	18.1	124	41.1	46	402	9.1		349	2.2
226	30 Jun	10:07	11	42	18.0	124	34.9	29	155	9.1	11	351	6.4
227	2 Jul	10:54	8	43	28.3	124	41.9	22	436	10.8		358	1.9
228	2 Jul	12:15	9	43	28.4	124	51.0	24	538	11.1	14	359	1.8
229	3 Jul	4:26	23	43	47.5	124	31.0	78	155	7.5		362	2.0
230	3 Jul	6:19	14	43	47.4	124	40.3	45	399	8.1		363	0.4
231	3 Jul	8:24	13	43	47.7	124	56.1	41	829	9.3		364	0.2
232	6 Jul	8:52	19	43	57.7	124	54.4	30	86	8.8		365	0.0
233	7 Jul	9:20	38	44	7.3	124	55.1	122	164	7.2		367	2.1
234	7 Jul	10:19	13	44	7.5	124	55.0	27	165	9.6		368	0.6
235	10 Jul	5:02	22	44	48.1	124	34.1	85	253	8.1	15	370	0.5
236	10 Jul	5:46	18	44	48.2	124	34.2	27	258	10.5		371	311.5
237	10 Jul	6:56	19	44	47.7	124	31.0	19	185	13.7		372	7.5
238	11 Jul	7:04	62	45	18.0	124	46.5	463	581	5.4		374	1.2
239	11 Jul	8:33	16	45	18.1	124	46.6	28	583	12.9	14.8	375	1.9

Table 6. Continued.

									Temp.				
Haul	Date	Time	Duration		Start	Position		Depth (m)		Temp. (°C)		Profiler	Catch
no.	(2001)	(GMT)	(min.)	La	titude	Longitude		Geara	Bottom	Gear <sup>b</sup>	Surface	No.	(kg)
240	12 Jul	11:44	24	45	47.9	124	10.0	91	105	6.8	12.5	378	2.0
241	13 Jul	20:27	26	46	16.4	124	25.6	71	427	7.5	12.5	381	27.2
242	14 Jul	10:25	58	46	30.7	124	32.6	397	582	5.8	12.2	383	1.8
243	16 Jul	12:10	14	47	17.3	124	33.4	45	68	7.4	11	393	2.7
244	17 Jul	9:04	22	47	28.0	124	40.1	75	84	7.2	12.2	397	0.5
245	18 Jul	7:35	19	47	58.3	125	30.2	57	171	7.6	13.1	400	3.5
246	18 Jul	8:11	13	47	58.3	125	29.0	20	173	11.4	13.1	401	1.8
247	18 Jul	10:58	35	47	57.5	125	14.0	101	171	7.5	13.2	402	6.0
248	19 Jul	7:40	25	48	7.7	125	1.5	71	269	7.7	14.2	404	7.9
249	19 Jul	8:42	18	48	7.9	125	1.5	24	263	9	14	405	6.8
250	19 Jul	9:51	26	48	7.9	124	58.7	149	169	7.1	14	406	4.1
251	19 Jul	10:43	20	48	7.8	124	58.7	26	165	9.1	13.6	407	2.9
252	19 Jul	16:38	20	48	18.1	125	4.7	. 139	164	6.5	12.2	409	3.6
253	20 Jul	10:47	15	48	19.9	125	52.6	24	411	9.5	13.3	412	2.3
254	20 Jul	12:25	19	48	24.0	125	59.0	85	193	7.4	13.4	413	7.9
255	22 Jul	12:12	12	48	43.2	126	16.7	21	496	11.4	13.2	426	2.0
256	27 Jul	9:53	47	48	54.1	126	31.3	252	509	5.8	11.3	444	6.1
257	27 Jul	11:20	15	48	54.3	126	32.4	28	531	8.6	11	445	3.1
258	27 Jul	12:06	19	48	54.1	126	30.1	122	175	7.3	11.3	446	4.9
259	27 Jul	12:44	17	48	54.2	126	30.5	27	181	9.3	11.2	447	9.1

<sup>&</sup>lt;sup>a</sup> Maximum depth

<sup>&</sup>lt;sup>b</sup> Temperature at maximum gear depth

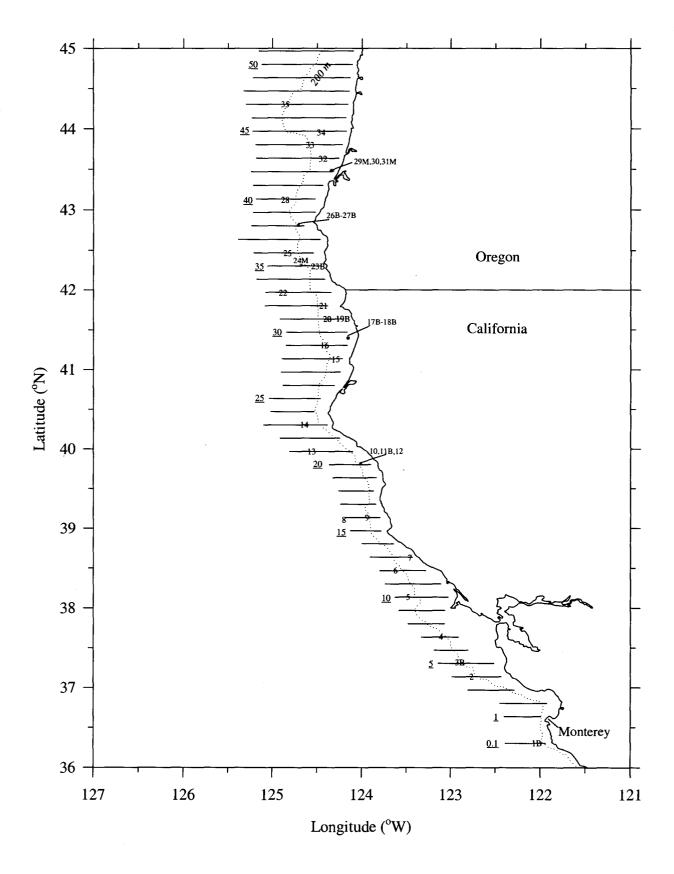


Figure 1. Survey trackline with haul locations for the Aleutian wing trawl, poly Nor'eastern bottom trawl (B), and Marinovich trawl (M) during the 2001 Pacific hake echo integration-trawl survey of the U.S/Canadian west coast, MF2001-08. Underlined numbers indicate transect sequence.

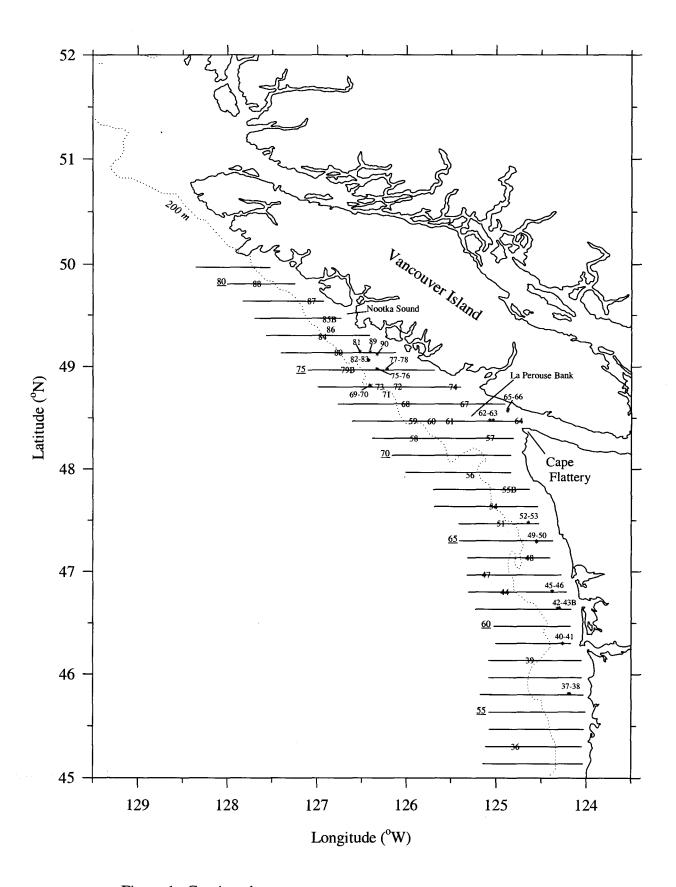


Figure 1. Continued.

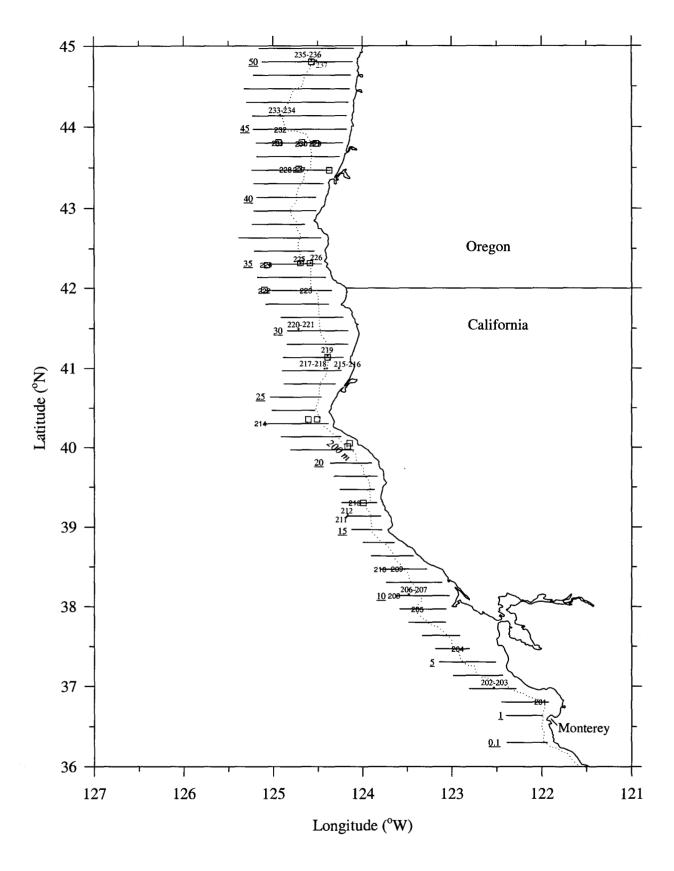


Figure 2. Survey trackline with bongo (square symbols) and Methot trawl haul locations during the 2001 Pacific hake echo integration-trawl survey of the U.S./Canadian west coast, MF2001-08. Underlined numbers indicate transect sequence.

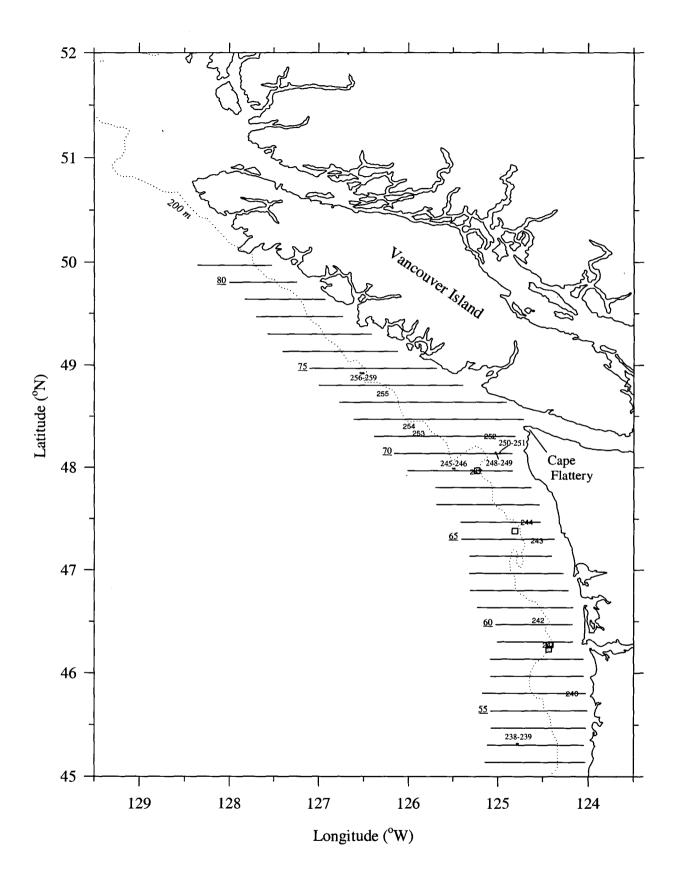


Figure 2. Continued.

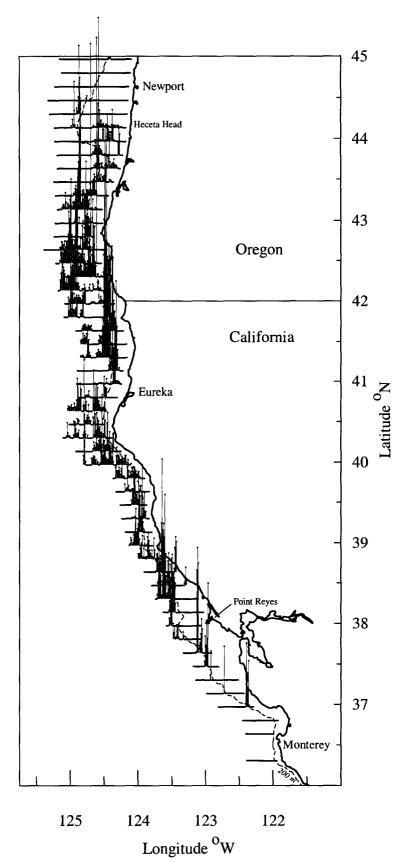


Figure 3. Relative acoustic backscattering attributed to Pacific hake along transects conducted during the 2001 Pacific hake echo integration-trawl survey of the U.S./Canadian west coast, MF2001-08.

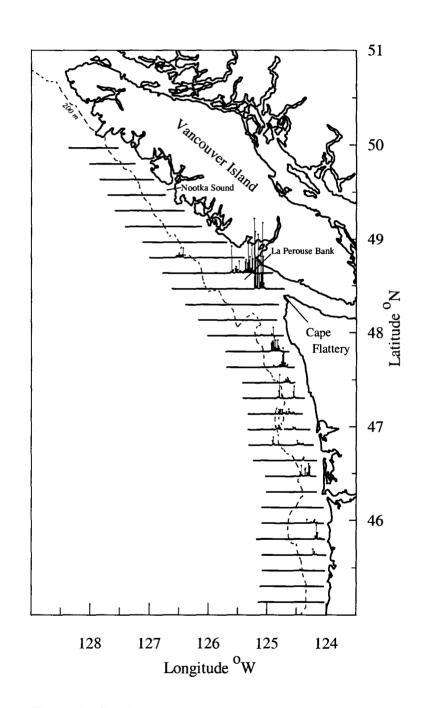


Figure 3. Continued.

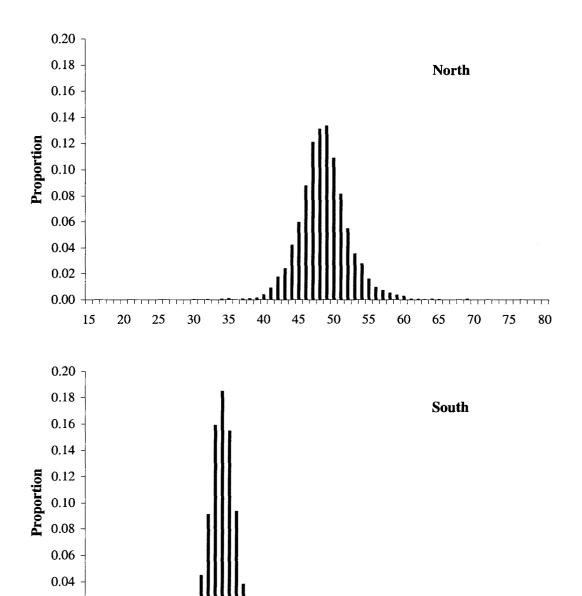


Figure 4. Pacific hake estimated proportion of numbers at length for regions north (top) and south (bottom) of Heceta Head, during the 2001 echo integration-trawl survey along the U.S./Canada west coast, MF2001-08.

Fork length (cm)

0.02

0.00 +

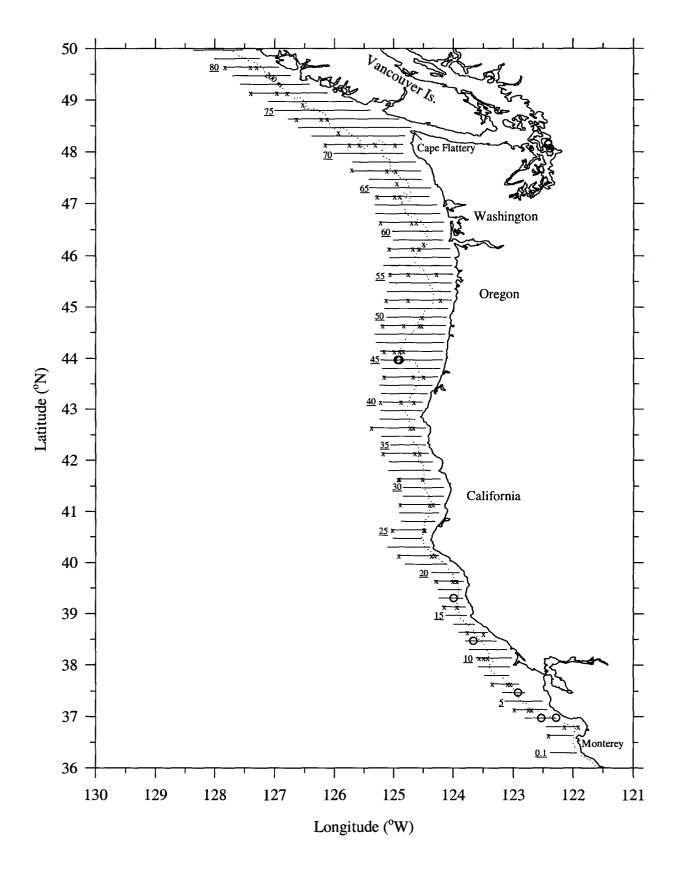


Figure 5. Survey trackline with expendable bathythermograph (x) and conductivity-temperature-depth (O) cast locations during the 2001 Pacific hake echo integration-trawl survey of the U.S/Canadian west coast, MF2001-08. Underlined numbers indicate transect sequence.